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ABSTRACTS

AGRICULTURAL INTELLIGENCE

GENERAL INFORMATION

DEVELOPMENT OF AGRICULTURE IN DIFFERENT COUNTRIES

899 - **The Agricultural Problem of the South of Italy and its Dependence on Biological Conditions.** — V. RIVERA, in *Atti della Società Agronomica Italiana*, Years II and III, No. 2, pp. 27-73. Rome, June 30, 1922.

The author draws attention to the low yield of Italian agriculture using the following figures, which show the average wheat yield in various European countries expressed in quintals per ha. : Italy 11.0 ; France 13.0 ; Austria 18.0 ; Germany 20.0 ; Switzerland 20.0 ; Holland 24.0 ; Ireland 25.0 ; Belgium 25.0 ; Denmark 31.7.

The problem of the low wheat yield of Italy has been treated from various points of view. Some believe that the progressive tendency which distinguishes agriculture in Northern and Central Europe, would if applied to Italy, cause field crops to flourish, even in the least productive part of the country; others including farmers, University professors and men of science, believe that owing to climatic and social conditions such crops are not really suitable for the South of Italy and that the growth of productive trees which suffer little from the effects of drought, should rather be developed.

The author has studied the problem of the crop returns in the South of Italy from the agronomic and economic points of view. During the 5-year period from 1909-1913, the yield fell to 9.59 qs. in Apulia, 8.3 qx. in Sicily and 7.1 qs. in Calabria, and never exceeded 20 qs. per ha. even in the best years.

From information collected in the district of Andria, the author has ascertained that the total profits from wheat are 300 to 400 lire per ha.,

from oats 100 lire and from barley 50 to 100 lire, while beans show no profit at all.

The vine yields on an average 75 qs. of grapes per ha. giving a return of 1000 to 1500 lire; cereals show a return of 200 lire. The olive alone can be cultivated with an absolute certainty of profit. The cultivation of mustard is being extended with satisfactory results.

In order to ascertain the reasons for these facts the author has carried on experimental research for 3 years at San Sisto, near Aquila, on the crops mostly grown in the district, where he has grown in the open field and by the most improved methods beans, lentils, wheat, maize, potatoes and the castor-oil plant. Organic fertilisers (manure) and superphosphate have given very good results with crops carried in April and May, but leguminous plants and cereals cropped in June and July yielded no profits, for they suffered from drought during the transition from Spring to Summer.

An analysis of the results shows that crop growing was disastrous from the economic point of view as regards all the trials made, with the exception of that of wheat. The greatest loss was on the castor oil plant for which it averaged, for the three years, 620 lire per ha.; then follow, in decreasing progression, lentils with a loss of 227 lire, potatoes 178 lire, beans 85 lire, maize 75 lire; wheat on the other hand showed a profit of 175 lire 60. For this reason the peasants of Central and Southern Italy prefer to grow wheat.

The inferiority of the soil in the South of Italy depends on causes which it is difficult to rectify by means of improved methods and intensive culture. These causes are: the lack of water during the most important period of plant-life and the high temperature during certain hours of the day, which causes the closing of the stomata and consequently prevents assimilation; the luminosity of certain soils adds to the trouble by its injurious effect on the photosynthesis. The cultural factors are: bad tillage, excess of moisture in the initial stage of plant growth, etc. A comparison between the north and south of Italy shows that in the former there is an increase in the quantity of water and the height of the temperature from January to July, whereas in the latter, the water diminishes as soon as the temperature rises.

The propaganda in favour of the use of fertilisers in the dry districts of the south is considered untimely by the author as the fertilisers deprive the plants of their power of resistance to drought.

The author concludes by stating that the causes of the low agronomic and economic returns in the South of Italy are mostly due to climatic and biological conditions and that poor methods of cultivation have only a secondary influence. The measures adopted to remedy the evil should be based on the biological factors and the individual requirements of each plant as regards climate and exposure should be taken into account.

R. P

[899]

30 - **The Fertility of the Soils in Greece.** — BOUYOUCOS, G. (Michigan Agricultural Experiment Station), in *Soil Science*, Vol. 13, No. 2, pp. 63-72. Baltimore, Feb. 1922.

At the request of the Greek Government, the late C. G. HOPKINS, with the writer as his assistant, was sent to Greece by the American Red Cross and the War Board to investigate the soil productivity. Though the enquiry lasted only one year it led to decidedly interesting results. HOPKINS drew up a report which was addressed to the Government and the farmers of Greece. It was couched in a rather simple and popular form, and has not yet been translated into English. Had Dr. HOPKINS lived, he would no doubt have prepared a more scientific report. Yielding to the request of men of science, the author has now attempted to supply the deficiency.

Soil production in Greece is very low. For instance, the average wheat yield is only about 11 bushels to the acre, and this is produced only once in two years, or even in three years and during the interval the land is left fallow. The yield of all grain crops is low. As to legumes, only a few kinds are grown for human consumption. The culture of leguminous plants is practically unknown. The writer does not treat of fruit-growing.

The causes of the low yield are numerous. It is partly due to the use of unselected seed, to the high temperature and above all to the drought towards the end of Spring and during the Summer, which, in the absence of irrigation, renders cultivation difficult, but the chief cause is the sterility of the soil. The farmers do almost nothing to render the soil fertile. The majority of them have never used commercial fertilisers; farm manure is quite scarce, because in Greece the chief livestock consists almost entirely of sheep and goats which graze nearly the whole year on the mountains; the advantage of alternating cereals with legumes is unknown; the few leguminous crops grown are pulled up by the roots, so that the soil derives no benefit from the nitrogen. While lying fallow, there is no shortage of wild legumes, which are for the most part grazed by the flocks; the soils probably receive a little nitrogen from these plants.

Greece is a very mountainous country, but nearly all the cultivated land is of fine texture. It is rich in clay and silt, even when very stony. The chemical composition of the soil varies greatly, as is seen from about a hundred analyses given by the writer. For instance, for each ha. containing 2 250 000 kg. of soil, the nitrogen varies between 1687 and 1625 kg., the phosphorus between 236 and 13 185 kg., potassium between 2800 and 72 551 kg. and magnesium between 2000 and 51 918 kg.; the calcium variations are still greater, being 3200 to 140 000 kg., especially in the case of limestone, of which there is generally an excess, though sometimes it is entirely absent. As regards the soils deficient in lime some are acid, but these are comparatively rare. With very few exceptions, potassium, is generally abundant but phosphorus and nitrogen are often deficient.

The great influence of the chemical composition of the soil in Greece on its fertility is confirmed by two series of experiments made during the short time Dr. HOPKINS was able to work. Melilot was cultivated in 38 earthenware jars, and it was seen that phosphorus produced a marked

increase in yield. Thus in limestone soil the yield rose on an average from 32 to 105 gm. by the mere addition of acid phosphate. The melilot was afterwards partially dried and mixed with the soil in which the roots had been left. The result of planting millet in this was a much larger growth than that in the control. Eight field tests were also made in different parts of Greece. The writer only gives the results of two, in acid soils, namely, those to which limestone was applied at the rate of about 25 tons to the ha. and acid phosphate at the rate of about 5 qx. This caused a great increase in yield, which in one case rose from 150 kg. to about 3,100 kg. or twenty times more. The addition of lime or phosphate was much less beneficial. In general, during the course of this inspection in Greece, it was seen that the soils respond readily to fertilisers, especially to those containing nitrogen and phosphorus, and, if acid, of limestone. L. V.

901 - **Agriculture in the State of Parana (Brazil).** — MUNHOZ DA ROCA. *Mensagem dirigida ao Congresso Legislativo pelo Dr. Caetano* MUNHOZ DA ROCA, *Presidente do Estado ao installar-se a 2ª Sessão da 15ª Legislatura*, p. 106. Curityba, February 1, 1912 (1).

The importance of agricultural production in the national economy of the State of Parana is shown by the value of the exports during the financial year 1919-1920, dealt with in this "Message". The value of the exports taken as a whole reached the figure of 638 550 88 milreis of which 34 876 000 relate to maté — 11 991 500 to timber — 5 450 400 to live stock — 609 888 to coffee — 4 927 300 to miscellaneous produce. Maté thus represents more than 60 per cent of the State revenues.

With a view to placing on a sound basis and developing the two principal agricultural sources of wealth of the country, by the Decree No. 1201 of November 17, 1920, the period in which the picking of maté is allowed is confined to the season from May to October, and the analysis of the trade product is made obligatory under the guarantee seal established by Law No. 1956 of March 23, 1920: Law No. 1986 of April 5, 1920 fixed the times during which the felling of timber is permitted, and makes obligatory the reafforesting of clearings, leaving to the person concerned the choice of trees to be planted.

The State supports the following institutions for agricultural instruction and experiment: "Escola agronomica" of Curityba founded by Law No. 1788 of April 5, 1918, which had in 1920 93 students: "Instituto Bercachery" devoted to experimental plantations with the object of making a study of the crops best suited to the climatic and general local conditions of the State: this Institute has been attached to the "Escola agronomica" and selection experiments, trials of fertilisers, practice in agricultural work, manual and with machinery, are carried on there:— "Campo do Portao" an experimental farm also attached to the "Escola agronomica" — "patronato agricolo" an orphanage which prepares pupils for agricultural work and a staff of inspectors of agriculture. An experimental station for seed production is just about to be founded.

(1) For other information as to the agriculture of the various Brazilian States, see R July 1922, No. 681 and the bibliographical note. (*N. d R.*)

Subsidized colonization has come to an end, but the State encourages colonization either by giving facilities to the colonist for the acquisition of land vested in the Federal Government or in private undertakings, or by assisting communes to do the same, or finally by acquiring land on its own account for assignment to colonists. Law No. 1642 of 1916 fixes the conditions under which land can be granted to private persons: in application of this law 1 100 000 hectares of land have already been distributed in Parana, the greater part to Brazilian colonists, natives of Rio Grande do Sul. F. D.

902 - **Agriculture in Martinique.** — *Bulletin Agricole de la Martinique, Revue trimestrielle publiée par le Service de l'Agriculture,* Year IV, No. 22, pp. 49. Fort-de-France, 1922.

Department of Agriculture and Forestry: organisation and working. — The inauguration of the Department of Agriculture coincides with the establishment of the trial plots at Tracée, Tivoli and at Prefontaine and of an agricultural laboratory; these were established by the law of March 11, 1904. The law of January 20, 1909 set out the duties of the department and the law of April 26, 1909 instituted new trial plots as well as agricultural instruction.

As at present organised, the essential aim of the department of Agriculture is on the one hand to improve the crop yield and the industrial output of sugar cane by the application of improved methods, and on the other to encourage the development of the so-called secondary crops, so as to safeguard the colony against the dangers of a single cultivation. At the present time it consists of two separate sections: that of agriculture properly so-called and the forestry section.

The functions of the agricultural section and its programme of action may be summarised as follows:

1 *Scientific and experimental research:*

a) in the laboratories of agricultural chemistry and technology, entomology and phytopathology.

b) in the nursery gardens and experimental plots, the subjects treated being sugar-cane and the so-called secondary crops: cacao, coffee, citrus fruits, etc.

2. *Agricultural instruction and propaganda:*

a) agricultural instruction in the primary schools, in the training colleges, in the secondary schools, and in a special school of agriculture;

b) propaganda and information, by means of consultations either through the post or by interviews and publications.

3. *Agricultural improvements and rural engineering* (drafts and plans, inspection of constructional work in progress and maintenance work).

4. *Encouragement of agriculture:*

a) prizes for secondary crops, for agricultural instruction, etc.;

b) payments and subsidies for permanent improvements such as drainage, irrigation, etc.;

c) agricultural shows and competitions;

d) co-operation and agricultural mutual aid through syndicates, co-operative societies, credit corporations, etc.

In regard to the *forestry section*, its functions include:

1) the oversight and preservation of the existing forests whether belonging to the State or to private persons;

2) the scientific management of State woods and forests;

3) reafforestation; regulation of rivers and waterfalls.

The budget of 1922 includes: for administration and laboratories 48 000 francs; trial plots 103 600 francs; forests 60 600 francs. It includes further a credit of 50 000 francs for reafforestation and another credit of 30 000 francs for the encouragement of agriculture.

The essential business of the trial plots is to prepare and distribute free of charge to agriculturists who make application, seedlings, etc. of the best kinds of useful plants, sugar cane excepted. During the decade 1912 to 1921, more than 1 100 000 seedlings were distributed, of which 177 000 in round numbers were coffee plants, 64 000 cacao, 476 000 citrus fruits, 294 000 tobacco plants, and 183 000 miscellaneous.

The forests cover about 20 000 hectares, of which 7 000 belong to the estates of the Colony and 13 000 to private persons. The annual coefficient of increase may be estimated at from 5 to 6 cubic metres, representing an annual production of at least 100 000 cubic metres, that is to say double the consumption of the island.

Sugar cane cultivation and subsidiary industries. — Out of a total area of about 98 000 hectares, of which 76 000 are volcanic lands in the north and 22 000 are alluvial lands, the sugar cane occupies nearly 27 000 hectares, of which only 18 000 are cut each year, the remainder being partly under rotation (fallow, green manuring or pasturage) and partly planted with young canes. All the land suitable for the cultivation of cane is already planted, so that there seems no likelihood of any increase in the area covered by this crop. On the other hand it is possible to increase production by improving the methods of cultivation and of manufacture; by these means the present production might be raised from 30 000 to 100 000 tons per annum.

At one time the yellow cane of Otahiti or the Bourbon were almost exclusively cultivated, but for thirty years past, owing to the fact that the older varieties have undergone degeneration, numerous varieties obtained from seedlings have been introduced from British Guiana, Demerara and Barbadoes. On the Congo, these varieties also degenerate, those from Barbados sooner than those from Demerara. As a general rule it may be said that their introduction is useful, as tending to preserve, if not to develop the cultivation of the sugar cane

The first sugar harvest takes place 18 months after plantation: the second (first suckers) 12 or 14 months later; the third (second crop of suckers) is left on the ground and used for pasturage for three or four years.

There are in Martinique at the present time 15 sugar factories. The sugar of the first flow reaches 98.8 degrees of polarisation: few sugar

actories have an output showing a lower polarisation than 97. The second low polarises at 95 to 97 on an average. Local consumption absorbs about a thousand tons per annum: the remainder (30 000 to 40 000 tons of all types) is exported to France.

The cane-trash is used for fuel: one ton of cane supplies 200 kg., with 5 % of humidity, equivalent as fuel to at least 50 kg. of coal. The scum of the boiling is mixed with chopped straw and used as forage: 10 kg. is obtained per ton of sugar-cane. The molasses is used in the manufacture of rum. Generally it contains 54 to 58 % of absolute saccharine and from 20 to 30 % of directly reducing sugars as against 30 to 40 % of saccharose. The average density is 1.40 and the theoretical yield is 90 l. of rum at 55 degrees per hl.: the actual yield is 75 to 80 % corresponding on an average to 24 l. of rum per ton of sugar cane.

Secondary crops and subsidiary industries. — The most important of these is the cultivation of the cacao-tree which occupies about 1 500 hectares in the north of the island. During the five years 1917-21, an average of 400 000 tons of cacao beans has been annually exported against an average of 500 000 tons during the pre-war period.

The chief varieties cultivated are: Criollo, Venezuela, Calabacillo. The principal shelter-trees are: Glyricidia, Samana (*Pythecolobium Saman*). The annual production is about one kg. of beans per tree and in the better cultivated plantations as much as two kg.

There are three chocolate factories which can turn out 1 200 kg. of tablet chocolate per day, and two cocoa powder factories which can together work up 2 000 kg. of cocoa beans a day.

Coffee which was lately cultivated on a large scale, has been seriously attacked by two parasites: the eel worm (*Heterodera radicicola*) and the butterfly known by the name of *Cemiosoma coffeola*, the larva of which eats the leaves. For some years past the replanting of the plantations with *Coffea liberica* and *Coffea robusta* has been proceeding.

The shade trees most usually planted are the sweet tamarind (*Inga edulis*) the samana and the glyciridia.

Since 1910 the cultivation of the lime-tree has been much developed, especially that of the *Citrus medica* var. *acida* which is used both for direct consumption, and for the preparation of the concentrated juice, and of citrate of lime, which is manufactured in four factories in the island, and also of the essence extracted from the rind.

Tobacco grows wild in Martinique as in all tropical America. The "Grand Martinique" must be an original variety. This was formerly a flourishing crop and is in a fair way to revival: the quality of the product is very good.

Cotton (*Gossypium arborescens*) is wild or cultivated all over the island, but cultivation properly so-called is very limited. It formerly covered thousands of hectares. The long staple variety (*Sea Island*) is the best suited to the island.

There is no textile industry in Martinique. Nearly all the natives make rope with aloe fibres, called "ox tongues" (*Agave rigida*), with manilla hemp or banana fibre (*Musa textilis*), with the bark of different plants, parti-

cularly the malvaceae of the genera *pavonia* and *pariptium* and of the boragaceae of the genus *cordia* called by the Martinique planters "mahot".

For making baskets, etc. the "aroua" (*Maranta juncea*) is used; for making fishing tackle bamboo; for ordinary hats, the leaves of certain palms, especially "latanier" (*Thrinax barbadensis*).

Vanilla grows well in Martinique, but its cultivation has been neglected to such a degree that in several years the production was not enough for local requirements. The average annual export during the last ten years was 1900 kg. The *Vanilla aromatica*, which is of little commercial value, grows wild: the two following kinds are cultivated: "Mexican vanilla" (*V. planifolia*) and the "vanillon" (*V. claviculata*).

There are unimportant exports of nutmeg and cinnamon and ginger; pepper and cloves are produced in scarcely sufficient quantities for local consumption.

Stock breeding. — This is quite inadequate for the requirements of the local food supply, the provision of draught animals and the supply of manure. There are approximately: 10 000 horses; 25 to 30 000 cattle; 30 000 sheep and goats and 20 000 swine. There are 12 000 hectares of meadow land and grass land in the island to which must be added 6 to 7 000 hectares of fallow, so that the effective area available at present might be doubled.

The creole horses are small ($1^m.30$-$1^m.40$) easily handled and hardy. They feed on Para grass (*Panicum molle*) or Guinea grass (*Panicum maximum*), green sugar cane tops at the time of cutting, cane scum, dry straw chopped and mixed with molasses.

There is no horse breeding properly so-called.

There are a fair number of mules: those of native breed are small (about $1^m.30$), while those which are imported from Porto-Rico or the United States are larger and stronger, but need more food.

The stock of cattle is made up of animals of small size originating in the crossing of the various breeds that have been successively imported into the colony. There are no special breeds of butchers' beasts or dairy cattle. The better cows give at most 4 to 5 litres of milk. The yield of butchers' meat is from 40 to 60 % and the meat is of ordinary quality.

The sheep own their origin to the crossing of the South American breeds with those coming from Senegal.

The swine are reared round the dwellings: they recall the Iberian breed.

F. D.

903 - **Agricultural Implements in Syria and Lebanon.** — *Service de l'Agriculture du Haut-Commissariat de la République Française en Syrie et au Liban. Enquête sur le matériel agricole se trouvant en Syrie à la date du 31 décembre 1921* (1), pp. 1-11. Beyrout, Jan. 21, 1922.

Included is a table giving statistics for each kind of horse ploughs, threshing and winnowing machines, implements, motor driven machines,

(1) Documents in support presented by the Temporary High Commissioner of the French Republic in Syria and Lebanon.

machines used in agricultural industries, etc.), of the agricultural implements in Syria and Lebanon on December 31, 1922. The report also shows: the type of the different machines, the districts possessing the greater number, the country from which sent if imported, the causes of their success or failure, improvements made or to be made in the construction or selection of types, where and by whom the trade in agricultural machinery is carried on and the terms of payment. The districts most adapted to the use of agricultural implements are also enumerated.

There are no contractors for ploughing or threshing anywhere in Syria. In the Province of Damascus some tractor owners let their machines out on hire to their neighbours. In the Province of Aleppo, in the Sanjak of Alexandretta and in the territory of the Alanites, the Agricultural Service has carried out contract work, allowed farmers the free use of various kinds of machines and in some cases has lent ploughs.

These advances have been well received.

The causes which operate against the use of agricultural implements in Syria are the following: the farmer supplies the material for the crops and when they are ready for the harvest the landlord advances the money necessary to carry out the work, the sum being calculated on the prospective yield. These advances are made at a very high rate of interest and after repayment there is a very small margin of profit; the farmer has no capital; there is a lack of practical knowledge and distrust on the part of the farmer and owner of every innovation; the implements imported, especially ploughs, mowers and reaper-binders are unsuitable for local conditions; lack of initiative on the part of the large landowners; the poor and weak condition of the draught animals; the lack of repair sheds and depôts for spare parts.

The following are recognised in this report as essential factors in the extended use of agricultural machinery: a change in the methods of farming, the opening of a credit fund by the Department of Agriculture, the spread of technical and practical instruction in agriculture, the extension of the knowledge of the results obtained by the use of agricultural machinery, the development of the breeding of draught animals, the adaptation of machinery, the building of repair sheds and depôts for spare parts and the establishment of companies for carrying out agricultural work on contract terms.

F. S.

904 - **The Teaching of Soil Bacteriology.** — BROWN, P. E. (Professor of Bacteriology, Iowa State College, Ames), in *Journal of the American Society of Agronomy*, Vol. 13, No. 8, pp. 323-329. Washington, Jan., 1922.

AGRICULTURAL EDUCATION

It has been said that soil science is the basis of agriculture. It covers an extensive field and the fact that it is now taught in several courses is not only through pedantry but also because it has been found necessary in order to impart a thorough knowledge of the subject.

From experience gained at Iowa State College it may be taught with advantage in four courses, of which one is general and introductory, one final and applied and two intermediary on fertility (especially as connected with chemistry) and on bacteriology.

Soil bacteriology is a branch which has only recently been differentiated from agricultural bacteriology. In the *curriculum* of nearly all agricultural schools it has not yet been treated as an independent branch, but it is nevertheless of growing importance. At present soil bacteriology can no longer remain an accessory, almost fortuitous subject, included in agricultural bacteriology.

Up to the present time there is still a lack of special works on soil bacteriology ; instruction should therefore be oral, and enlivened by discussion and written work, which greatly tend to enlighten the mind.

Certain subjects, such as nitrogen fixation, nitrification, the carbon cycle, the sulphur cycle, the phosphorus problem, the part played by fungi, the occurrence of protozoa etc., should be emphasized particularly ; others of minor importance, such as denitrification, should be minimized. The subject matter should not be too technical and intricate, but simple and concrete and directed towards enlightenment in the practice of agriculture, tillage, manuring, liming, drainage etc. It should arouse the attention and keep up the interest of the pupils ; and should be completed by demonstration and laboratory experiments. L. V.

905 - **Agricultural Instruction in Belgium.** — MINISTERE DE L'AGRICULTURE, *Situation de l'Enseignement Agricole, Rapport triennal avec Annexes, présenté aux Chambres Législatives par M. le Ministre de l'Agriculture*, Years 1918, 1919, 1920, pp. XXIV + 219. Brussels, 1920 (1).

Except for some schools, where the apparatus was completely destroyed in the war, courses and demonstrations have been resumed everywhere. Under the impulse given by the Administration, the subsidised schools are acting as far as possible on the new requirements created by the war: they are improving their methods, revising their syllabuses and completing their schemes.

Chief Council for improvement of agricultural and horticultural instruction. — This Council which was created by a Royal decree of 31 March 1919, and is composed of the most outstanding personalities of the educational and agricultural world, has brought to the task of the restoration of agricultural instruction in Belgium the fruits of a most careful collaboration. The Council deliberates on all questions and subjects relating to the progress of agricultural and horticultural instruction. It includes 12 members with the right to vote and a certain number with the right of speaking but not of voting. It consists of five sections: 1) Higher agricultural instruction; 2) Ordinary agricultural instruction; 3. Popular agricultural instruction; 4) Ordinary and popular horticultural instruction; 5) Farmhouse management.

Higher agricultural instruction. — Important modifications have been introduced into the organisation of higher agricultural instruction. The law of November 15, 1919, relating to agricultural instruction, has replaced that of April 4, 1890, and has made possible the creation of a Flemish

(1) See *R.* July-August 1920, No. 713. (*Ed.*)

Agricultural Institute. A new Royal decree of April, 8 1920, regulates the conditions of admission to the Higher Institutes of Agriculture and the ratification of the diplomas issued by these institutions. This decree established diplomas of "Licenciate in Agronomic sciences", to be given after two years study: it extends to 4 years the period of study for obtaining the diploma of "agricultural engineer» namely two years of general studies leading to the diploma of "candidate for agricultural engineering" and two years of specialisation leading to the diploma of: agricultural engineer, colonial agricultural engineer, engineer of Waters and Forests, rural engineer, horticultural engineer, engineer of agricultural industries or engineer, of chemical agriculture.

State Institute of Agriculture at Gembloux. — Courses were suspended during the academic year 1917-18. The admission of 200 students since the re-opening speaks well for the reputation of the institution. Changes have successfully been made in the system of farming, and the farm is now chiefly experimental and a demonstration ground.

State Institute of Agronomy at Ghent. — The State Institute of Agronomy at Ghent was established by the Royal Decree of May 25, 1920, in application of the law of November 15, 1919. The courses are given in Flemish. The first academic year opened on October 19, 1920 with 20 regular students. The State has acquired a property of 60 hectares, situated at Melde, as an experimental farm annexe to the new Institute.

Higher Training Institute of Farmhouse Management at Laeken (1).

Intermediate Agricultural Instruction.

State School of Practical Agriculture at Huy.

The programmes of work have been thoroughly revised and a year of preparatory studies has been arranged. New courses have been established including agricultural machinery and the Flemish language.

In drawing up programmes, recent advances of science have been kept in mind and practical courses on motorculture have been held.

There are at present 51 students. This figure is a decided advance on those of previous years. Several lectures have been given by members of the staff, with the satisfactory result of making the school better known.

State aided schools of agriculture.

Carlsbourg School of Agriculture.— The courses have as their special aim the questions of intensive production, motorculture and the improvement of rural life.

Louvière School of Agriculture (*Institute of St. Joseph*).

Leuze School of Agriculture. — The syllabus has been completed by lessons on stock breeding and the feeding of cattle. In view of the renauguration and reorganisation of stock breeding syndicates special courses have been given on milk analysis.

Agricultural School departments in receipt of grants. — These are the following: the intermediate agricultural departments at Aerschot, Avelghe, Brée, Brugelette, Buggenhout, Chimay, Dinant, Ellezelles, Enghien, Fleurus,

(1) See *R.* Oct. 1921, pp. 1295-97. (*Ed.*)

Hannut, Hasselt, Opwyck, Saint-Trond, Schadeck-Attert, Sotteghem, Thielt, Thuin, Tirlemont (Collège Notre-Dame), Tirlemont (École Provinciale), Tongres, Virton, Visé, Waremme, Wavre (Institut Saint Jean-Baptiste), Wavre (Ecole provinciale).

Grant-aided Private Schools and Departments of Farmhouse Management. — These schools are in a very satisfactory condition. An agricultural education given to girls side by side with a general education is much appreciated by those concerned, in spite of the marked tendency after the war to leave the country districts in search of an intellectual culture alien to the agricultural sciences.

The Farmhouse Management schools in receipt of grants are the following: farmhouse management school of Bastogne, Berlaer-lez-Lierre, Bouchout, Brugelette, Celles (Hainaut), Ciney, Cortemarck, Herve, the higher agricultural school for girls at Héverlé, the farmhouse management school at Locre, Marchet-les-Dames, Maulde, Overyssche, s' Gravenwezel, Tessenderloo, Virton, Wavre Notre-Dame.

The Farmhouse Management sections in receipt of grants are the following: the farmhouse management section of Balegem, Brugelette, Champlon, Jodoigne, Ressegem, Vezon, Waremme and Zeelhem

Courses of Agronomy in the State higher and Intermediate Schools. — These courses were suspended in 1918, and resumed in the following year.

Courses of Agronomy in the Intermediate Private Schools. — 52 courses of agronomy have been organised in these institutions during the last three years.

Elementary agricultural instruction.

Technical agricultural departments for boys.

These departments are local and usually attached to the rural primary schools, or are travelling schools. The form of agricultural instruction followed in these winter courses is well adapted to the routine of agricultural life. Several new sections came into being during the three years under consideration, though on the other hand several ceased to exist.

Schools of agricultural machinery. — These with their highly specialised programme are much appreciated.

Travelling Farmhouse management schools. — After the armistice the schools restarted their activities to the great advantage of the rural population who much appreciate the instruction given. Five new schools, at Beirendrecht, Heyst-op-den Berg, Campenhout, Clytte (Reninghelst) and Yvoir, were established in 1919.

Popular agricultural instruction.

Lectures given by the State Agricultural Experts.

These lectures given on subjects of general interest to the cultivators of the district are always much enjoyed by their many listeners. The experts find these gatherings an opportunity of becoming acquainted with the farmers and of establishing valuable relationships with them.

Agricultural lectures to adults.

Beginning from the armistice these lectures are intended to draw the the attention of cultivators to the means that can be employed to bring

about an immediate increase in agricultural production. In this connection peripatetic lectures were instituted in 1920 to introduce farmers to the method of sorting potatoes in sizes. There is at present a tendency to replace adult courses by these more detailed courses providing a more thorough and methodical instruction.

Lectures for farmers' wives.

These are a much appreciated type of agricultural instruction and also one of the most valuable.

Courses in poultry rearing.

These courses are well attended not only by amateurs but by farmers who are trying to improve the conditions of poultry farming.

Bee-keeping courses.

Courses in bee-keeping organized on the initiative of the bee-keeping federations are attended by bee-keepers anxious to learn and to improve their methods of management.

Courses in agronomy for soldiers.

In 1920 the Department of Agriculture instituted experimentally, courses for soldiers in barracks.

Special lectures.

A large number of special lectures have been given by the agricultural federations that are independently managed but under the inspection of State experts. These lectures are intended to give a fresh impetus to agricultural associations and to keep their members in touch with advances in agricultural science.

Demonstrations in the scientific feeding of stock and in experimental plots.

Whereas Belgium used to consume the largest quantity of fertilisers per unit of area, there has been a considerable falling off at the present time. On the other hand it has been impossible to renew sowing at the proper time and hence there has been deterioration in this respect also. Lastly prepared cattle foods have been used on a reduced scale only on account of their scarcity and high price. With the object of remedying these conditions and of bringing about an increase of agricultural production, the Department of Agriculture has instructed the State experts in agronomy to undertake the following experiments:

1) to show that in spite of their high prices the use of chemical manures is still profitable;

2) to examine the question of the most economical fertilisers in the present circumstances;

3) to spread information about fertilisers recently produced in any part of the country or as to possible sources of such production;

4) to distribute good kinds of seeds;

5) to prove the advantageous effect on milk-yield of an increase of protein in the diet.

Some of the experiments undertaken are given below:

a) trials on a uniform basis throughout the country dealing with the different nitrate manures; the different phosphatic manures;

b) trials on a regional basis of selected varieties of wheat, barley and oats, supplied by the Department, besides one or more local varieties supplied by the experimenter ;

c) trials, according to plans laid down by the State experts, bearing on the selection of seeds, especially potatoes, and on the effect of a second tillage on cereals ;

d) Experimentation on cattle-feeding.

Department of Agricultural Information.

The agronomic station at Gembloux consists at the present time of the station for agricultural chemistry and physics ; the dairy station ; the phytopathological station ; the rural engineering station ; the entomological station ; experiment station for seed improvement ; the forestry station.

Inspection of agricultural instruction.

The committee for administration and supervision, the inspectors of agriculture, the inspectresses of farmhouse management, and the State Agricultural Experts have had the oversight of the working of agricultural education in varying degrees. The reports prove that on the whole the different institutions fulfil their objects.

Schools of horticulture. — The State schools are: the Ghent school of horticulture and the school of horticulture at Vilvorde.

The schools subsidized by the State are those of Carlsbourg, Liège, Mons and Tournai.

Temporary schools of horticulture. — In most of the centres of professional horticulture temporary schools were established with the object of making it possible for practical gardeners to profit by the practice in other parts of the country, and to apply the results of science to their own work.

There were also temporary schools where it seemed likely that market gardening or orchard work could be started. The number of schools amounted to 45 by the end of the period.

There are also courses on fruit growing and market gardening and lectures on fruit growing, market gardening and horticulture. F. S.

906 - **Agronomic Investigation and Research in Italy.** — BORGHESANI, G. A., in *Atti della Società Agronomica Italiana*, Years II and III, Vol. 2, pp. 104-109, Bibliogr. Rome, June 30, 1922.

The writer observes that the "*statistical*" *method* introduced into physics and chemistry by MAXWELL by the study of the theory of heat, has been applied to industry, in which it has led, among other things, to manufacture in bulk and series ; its application has also been very successful in biology and agronomy. By means of statistical classification, it has been possible to make selection chronologically but spatially after a few years only, of the best types of plants and of the methods of fertilisation best adapted to soils, various cultures, etc. A statistical department has already been instituted in Egypt for plant selection (cotton, maize, etc.). The famous station at Rothamsted has

lso founded a statistical laboratory. In Germany the adoption of the ew method has been retarded owing to the fact that workers are still o much under the influence of the old experimental empiricism. In ther countries, such as France, Spain, etc., scientists are still less up to ate in the matter of agronomic research than in Italy, where each of the gricultural experiments carried out up to the present can bear critical xamination.

In order that the data collected may be arranged mathematically, ley should be sufficiently homogeneous, definite and numerous, hence le necessity of coming to an agreement with regard to publishing uniform andards for experimental work and observation on broad lines. The riter suggests that the " Società Agronomica Italiana " should take p the problem, entrusting the solution to a competent committee comosed of agronomists, biologists and mathematicians. The Society, it lould be noted, has already taken steps in this direction by organising ollective research.

To carry out this aim considerable financial resources are required. he author calls the attention of the State, the local consumers' cooperave societies, agricultural institutions and farmers to the fact that the eriod of unaided science, is drawing to a close. To-day research-work eeds definite financial support; the funds are used for cost of material, nplements, staff, travelling for first hand investigate and controls. The uthor criticises the increase of stations poorly equipped and over specialed, such for instance as that for maize-culture; it would be better to mit the number but to provide a better equipment, and also substaons for each particular crop and specialists.

The author proposes to the Society the following programme of rearch-work: 1) a soil map of Italy; 2) the nitrifying power and fertity of Italian soils; 3) comparative tests as to the effects of liming ccording to soils and cultures; 4) research and comparative tests on the ost efficacious use of stable manure and organic matter; 5) research nd comparative tests on the efficacy of phosphates and other phosphatic rtilisers; 6) the possible influence of superphosphates on the oligoynamic elements: aluminium, iron, arsenic, etc.; 7) research and compaitive tests on the efficacy of new nitrogenous fertilisers; 8) research s to the most economic use of water for irrigation; 9) systematic research 1 " dry farming "; 10) study of the crop rotations best adapted to the ifferent regions of Italy; 11) registration of the local species of the chief lants cultivated in Italy; 12) registration of the principal local breeds cattle in Italy; 13) maintenance of fish ponds for intensive pisciilture; 14) revision of the methods of analysis for products useful for griculture; 15) unification and standardisation of the methods used in gricultural experiments; 16) revision of the principles of agricultural atistics in Italy. After research on these and similar questions has een organised and successfully carried out during the required period f years, means should be devised for applying the results obtained to le improvement of agriculture. R. P.

[906]

907 - **The Institute of Agronomic Research, France.** — BRUNO, A. (Inspecteur général des Stations Agronomiques de France), in *Chimie et Industrie*, Vol. 7, No. 6, pp. 1222-1224. Paris, June 1922.

On the July 30, 1922 a bill was presented in the Lower French Chamber for the foundation of an Institute for the development, promotion, organisation and coordination of scientific research in agriculture.

Before this bill was discussed, art. 70 of the Financial Law of April 30, 1921, was approved in the following form:

An Office for the development of Scientific Research as applied to Agriculture with the object of stimulating and intensifying agricultural production shall be established at the Ministry of Agriculture. This organisation, called "The Institute of Agronomic Research," shall be vested with independent powers in the administration of its civil and financial affairs. Its organisation, the conditions, under which it will work and the methods to be followed will be determined by a decree drawn up by the Ministries of Agriculture and Finance.

At the same time two millions were voted in Parliament for scientific research, and the Institute was founded with the following statutory orders, published in the *Journal Officiel* of Dec. 28, 1921.

To control, under the direction of the Ministry of Agriculture, the stations and laboratories already dependent on, and supported by, the Ministry, and also other stations and laboratories which it may be deemed expedient to open; the cost of building and upkeep will be borne by the Institute. It will also aid other stations and laboratories which have hitherto been maintained by the Ministry of Agriculture, and have the power to make payments to scientific experts engaged upon agricultural research. Its essential duties will be: to coordinate the work of specialists, encourage research, giving it a bias towards practical utility rather than speculative science, to found a central library and publish a summary of the scientific work carried out both in France and abroad.

The Institute was built at the beginning of 1922; and ROUX, Doctor of Science and State Councillor, was appointed Director. His Board of Administration is composed of a chairman and 28 members appointed for a period of 4 years, 6 members being chosen by the Academy of Science, 6 by the Academy of Agriculture, and 16 by the Ministry of Agriculture; among the latter are 3 Members of Parliament, 3 well known agriculturists or scientists, 3 members of Agricultural societies and one member proposed by the Ministry of Finance. The administration of the Institute resembles that of a municipality and an annual budget is issued. It is also in touch with the Sanitary, Scientific and Suppression of Fraud Departments. It has in its service 115 officials formerly attached to the laboratory service. It has under its direct control 24 stations or laboratories; 24 others, already supplied with educational facilities receive from it the staff and funds necessary for research work; and 36 other stations under the control of the Departments receive grants from the Institute.

Consequently the Institute can rely on the support of 84 regularly established bodies; it is organised on regular lines and its system forms a

etwork of which the junctions are the centres of agricultural districts with branches in the places where research is to be carried on. An agronomic engineer is placed in charge of the central office of documentation.

A central laboratory which will direct the work in progress at the other laboratories and carry out the more intricate tests, is established at Chèreloup (Rocquencourt) where 5 central stations will be erected on an area of 30 ha. : 1) one for physics and climatology; 2) one for cultivated soil; 3) one for plant breeding; 4) one for general pathology; and 5) one for zoology and agricultural entomology. The Institute will thus supply the present deficiency of specialised laboratories for science applied to human and animal food, for apiculture, oliveculture and dairy-farming. The existing laboratories will be assisted, strengthened, completed, and stimulated for their work; where required, new laboratories will be founded and placed in touch with the whole system.

The report made by the author describes the work which lies before the Institute of Agronomic Research. He is convinced that this task will be carried out methodically and at the same time vigorously and with set purpose, and that the Institute will not fail to contribute largely to agricultural progress. R. P.

CROPS AND CULTIVATION

908 - **Studies on the Reactions between Soils and various Chemical Compounds.** — SPURWAY, C. H., in *Michigan Experiment Station Bulletin* No. 51, pp. 5-29, bibliography of 10 works. East Lansing, Mich., 1921. SOIL PHYSICS

In order more accurately to interpret the reactions between soils and chemicals commonly applied as fertilisers the author considered that it was necessary to extend his investigations and experiments on the effects of these compounds on soils of different kinds, taking into account the nature of the soils as well as the specific action of the fertiliser salts and the compounds employed. The author is convinced that whatever may be the explanation of the processes which bring about these reactions, further progress depends upon an increase in our knowledge of the chemical constitution of soils and the practical significance of the soil components, and in devising analytical methods for the estimations of these components.

The difference in the results obtained and in the conclusions arrived at by many of the investigators engaged upon this question, is probably due to the fact that they have carried out their experiments with materials of different chemical constitution and composed of chemicals belonging to different groups, and also to the diversity of the analytical methods employed. On consideration of the work done in this field there appear to be three main ideas, or lines of thought: 1) that between the soil and chemical compounds there are chemical reactions only; 2) that the phenomena observed can be explained by physical forces; 3) that both chemical and physical reactions take place at the same time.

The author describes his experiments, undertaken as a study of the reactions between neutral salts, bases and hydrolysing salts, and basic

or acid soils of various classes. In these experiments the soil reaction was always tested with litmus paper. In order to eliminate the possibility of secondary and continuous reactions, which undoubtedly occur with slow filtration, the decantation method was used. The procedure was always as follows: 100 gm. of air dried soil were well mixed for one hour with 500 cc. of solution, usually 1/50 Normal of the salt under consideration, at laboratory temperature. The liquid was then decanted and filtered rapidly through paper. The extracts so obtained were analysed by standard methods for the particular salt. All calculations of results were based on 500 cc. of solution.

I. — *Treatment with neutral salts.* — Experiments were made with soils of various types, *e. g.*, sandy loams, silts and clay-loams, with and without carbonate, and with solutions of chloride, sulphate and nitrate of potash; sulphate and nitrate of ammonia; nitrate and sulphate of lime and chloride of magnesium. The analytical results obtained were recorded by the author in tabular form, and it appears that in practice in the reactions between the soil and neutral salts the cation only is retained. Practically all soils without exception precipitated the cations of neutral salts, and an equivalent quantity of another element contained in the soil was set free and passed into solution. The application of potassium salts caused the liberation of an equivalent quantity of other soil elements, particularly calcium and magnesium which went into solution. In the case of treatment with calcium, the calcium is fixed and magnesium goes into solution; with magnesium chloride the calcium is found in solution and a corresponding amount of magnesium is fixed. The actions were reversible in all the cases studied. After the reaction, with one or two exceptions, all the solutions were alkaline. Soils having an alkaline reaction fixed a greater quantity of cation than acid soils of the same class. There is strong proof that the reactions involved are chemical in nature and that the cause of fixation in soils is the presence of soil elements, chiefly calcium and magnesium, and that the degree of fixation is dependent upon both the kind and quantity of reacting elements present. A soil which has received an application of magnesium chloride is able to fix a larger quantity of lime than one not so treated.

II. — *Effects of Hydroxides.* — The same general methods were adopted as in the case of neutral salts. Experiments have been made with solutions of caustic potash and also with hydrate of lime. In these experiments it was found that soils of all types, whether of alkaline or acid reaction, fixed considerable amounts of potassium or calcium from their hydroxides without an equivalent exchange of other elements. After treatment with caustic potash the solution was alkaline to phenolphthalein and contained iron, aluminium and silica but the quantity of calcium was very small, much less in fact than the solubility factor for this element in the form of hydrate.

Evidently potash was fixed from caustic potash without an exchange of calcium or magnesium and in addition iron, aluminium and silica passed into solution in considerable quantities. The potash thus fixed could be

et free again and replaced by calcium on treating the same soil with olutions of the chloride or hydrate of calcium. In general it may be stated hat soils having an alkaline reaction fix a larger quantity of cations than hose with an acid reaction, although they may belong to the same class f soils.

III. — *Effect of Hydrolysing Salts.* — The same experimental methods were always followed in dealing with potassium orthophosphate, mono-alcium-orthophosphate, calcium acetate, potassium acetate, potassium xalate and iron chloride.

These salts may be grouped into four classes according to their action n the soil : *a*) salts with an alkaline reaction ; *b*) salts with an acid reac-on ; *c*) salts which form soluble salts by combination of their acid radical ith the soil elements ; *d*) salts whose radical acid forms insoluble com-ounds.

In general it may be said that under certain conditions salts which ndergo hydrolysis give results similar to those of neutral salts, but under ther conditions the results are quite dissimilar. When the acid radical f the salt is capable of forming a soluble compound with the soil elements reaction follows which is analogous to that obtained in the case of neu-al salts. The soil cation is fixed and then a quantity equivalent to that of e soil element goes into solution. When on the contrary, the radical acid the salt forms an insoluble compound with the soil element, usually in is case lime or magnesia, the two ions of the salt under consideration are ked by the soil, but in different proportions from the chemical standpoint. his implies that the two ions can be fixed independently one of the other. s regards the basic or acid reaction of a salt, it can be seen that when the action is alkaline, that is, when the acid radical is removed, the result the same as in the case of the corresponding hydroxide ; when the reac-on is acid the final result is the same as that obtained on treatment of a il with the corresponding acid. For example, on treatment with ferric loride, a salt with an acid reaction, the amount of iron fixed by the soil proportional to the quantity of lime found in solution, although it is ly in the case of soils rich in lime that an appreciable amount is found in lution. The experiments indicate that it is doubtful whether the iron ed by the soil can be replaced and that it is probably held in the hydr-ide form. Hence the reaction would not be reversible. It may be served that the alkaline soils fixed a greater quantity of cations from drolysing salts than the acid soils of the same class, and also, that greater antities of cations were fixed from hydrolysing than from neutral salts.

The data accumulated in this research point strongly to the conclusion at when neutral salts, hydrolysing salts or hydroxides in solution, are aced in contact with soils, a chemical reaction results in which the cations basic radicals of the added compounds are precipitated in the soil mass d the anions or acid radicals of the salts used form soluble compounds th calcium or magnesium, the resulting salts being found in the soil so-ion. When, on the contrary the radical acid forms an insoluble compound th calcium or magnesium, then that also is fixed or precipitated in the

soil. The results obtained are in accord with WAY's chemical hypothesis (*Journal Royal Agr. Soc.*, Vol. II, 13 and 15) and form an important demonstration of soil phenomena, particularly as regards the mineral constituents. These results justify the conclusion that almost all soils have acid and basic properties in common because they neutralise acids and also alkalies. The differences noted were quantitative only and these differences were generally in favour of alkaline soils over acid soils of the same type. Apparently the reaction of a soil is to a large extent determined by quantity relationships, the mass action of its components, above all by the quantities of the reacting masses involved.

A neutral soil then represents a case where the active masses of reserve alkalinity and acidity are equivalent.

The above is of practical value with regard to knowledge of soil fertility. In order that some fertilising element may be held, it is essential that the soil itself should contain some other reacting substances such as calcium or magnesium, which are probably present in the form of silicates.

This work shows the importance of making a special study of each soil if the best results are to be obtained from the use of fertilisers.

L. M.

909 - **Aluminium Salts in the Soil.** — DENISON, I. A. (Agricultural Experiment Station, University of Illinois) in *Soil Science*, Vol. 13, No. 2, pp. 81-106, bibl. of 16 works. Baltimore, Feb. 1922.

It is known that salts of aluminium are present in soils in considerable quantities and are partly responsible for soil acidity. The toxicity of these salts towards crops has been demonstrated by numerous investigations, but there is no definite information regarding their effect upon the processes of ammonification and nitrification. To solve this problem, the author carried out a series of investigations under the direction and with the aid of A. L. WHITING. Acid soils treated with distilled water left no trace of aluminium, so that this element cannot exist in a soluble form in the soil. On the other hand, it dissolved in a solution of potassium nitrate, the HOPKINS method for determining soil acidity. In this state it does not dialyse through a collodian membrane, and is present probably in the form of hydroxide. Under the influence of mineral acids which displace the aluminium, this hydroxide may give rise to soluble salts of aluminium which are the consequence, and not the cause, of the acidity. Aluminium salts stimulate ammonification, but act adversely upon nitrification, which is explained by the fact that they produce hydrogen-ions. Their influence gradually decreases, and after a couple of months the adverse action upon nitrification disappears. The same effect may immediately be obtained artificially by means of calcium carbonate, and in a lesser degree by tricalcic or monocalcic phosphate, because the calcium-ion precipitates the aluminium-ion. Under natural conditions, aluminium is never able to exercise a toxic action by means of its own soluble salts even in acid soils, because it is rendered or kept insoluble by such actions.

L. V.

10 - **Nature of Soil Acidity in North-East India.** — CARPENTER, P. H., and HARLER, C. R., in *The Indian Tea Association, Scientific Department, Quarterly Journal*, pt. III, pp. 121-144, bibl. of 32 works. Calcutta, 1921.

Soil acidity is insufficiently studied in tropical and sub-tropical coun-ries. The authors have studied it in the tea-growing districts of North-ast India, where it diminishes production, either because it lowers soil rtility or because it facilitates the outbreak of certain diseases.

Soil acidity may be due to various causes. Its extent may be measured y numerous methods, which react in varying proportions on the factors hich cause it; this explains why they do not agree among themselves. hey are based on hydrogen-ion concentration (electric conductibility, alories, saccharose inversion, liberation of iodine etc.), on neutralisation y means of bases or salts with a basic action, carbonate, bicarbonate and ydrate of calcium, barium or sodium, calcium acetate, etc., on a solution f weak bases (aluminium or iron contained in the soil) by means of neutral alts (potassium nitrate, soda nitrate, etc.). The authors find that these nethods, often too drastic, are all inexact or uncertain. The "Indian ea Association" recommended the ALBERT method modified by LYON nd BAZZEL. It consists of treating the soil first with barium hydrate, hen with ammonium chloride. The authors have used it largely, but do ot believe it is exempt from the criticism passed on the other methods. Though not perfect, they prefer HOPKINS' potassium nitrate method. t measures more especially the quantity of aluminium dissolved in the soil r capable of entering into solution. This method, then, not only en-bles the actual acidity to be measured, but also the potential acidity, hat is, that which may be liberated, which is of equal importance. The irst is united to soluble and ionisable aluminium silicates, the second to luminium hydroxide derived from silicic minerals in soils undergoing aterisation; this colloid's degree of hydration affects the latent acidity f the soil.

Aluminium also dissolves easily in calcium hydrate. This is surprising, ince calcium aluminate is insoluble; it is evident that the aluminium pass-s into solution as a silicate. It also dissolves in basic hydrates.

According to the authors, everything points to ionised aluminium s being the chief cause of the actual and potential acidity of the soils studied n India. In this connection, the authors remind us that CONNOR, ABBOT nd DAIKUHARA have proved that aluminium and iron may be found in he soil in a state of solution as acid silicates in the absence of sufficient uantities of lime and magnesia to neutralise these salts; also that the alu-ninium in solution sufficiently explains the lack of fertility in acid soils, s it has a direct toxic action on the plants and bacteria of the soil, even n minute quantities (1 : 1 000 000 of aluminium-ion).

The degree of acidity registered by HOPKINS' method differs entirely rom that determined by steeping the soil in lime or other bases, but there s a close parallel between this degree and the fertility. This shows the in-luence of dissolved or soluble aluminium (ionised or ionisable) in regulating ertility, and proves the importance of these determinations.

According to the authors, the acidity caused by aluminium, which is common in the tropics, is favoured not only by the absence of lime or magnesia, but also by the imperfect drainage, heavy rains, irrational methods of culture etc.

Potash added to acid soils always diminishes their fertility at first because it renders the aluminium salts soluble and increases their toxicity. But if the soils are light and permeable, the aluminium is rendered soluble and afterwards quickly liberated, as proved by MIRASO; thus, after the first year, the potash is very beneficial; the soils become better adapted to tea culture, the yield is considerably increased and certain parasites, such as the *Helopeltis Theivora*, disappear. On clay soils, however, which cannot be easily leached out, the aluminium remains even after having been rendered soluble by the potash, which only does harm. As the clay soils cannot be leached out, they collect soluble aluminium, which is the cause of infertility.

Lime, in the form of carbonate, superphosphate, etc., also has a good effect, similar to that of potash. According to the authors, this is due to the fact that it precipitates aluminium, renders it impervious to attack even from the acids freed from organic manures and fixes it strongly and permanently in the soil. Besides this, it neutralises acidity; probably these two actions are to some extent connected, whereas, according to HOAGLAND, they are only coincident. L. V.

911 - **Soil Acidity and Bacterial Activity.** — STEPHENSON, R. E. (Agricultural College, University of Kentucky) in *Soil Science*, Vol. 12, No. 2, pp. 133-144 and 145-162, fig. 1, bibl. of 13 works. Baltimore, Aug. 1921.

It has not yet been decided how and why soils become acid. In the decomposition of organic matter, bases and acids are formed, for instance, the processes of ammonification and nitrification. The products thus formed subsequently undergo changes; for instance, the acids react on the mineral substances of the soil, of which they hasten the disintegration and increase the availability, but which are sometimes precipitated, thus delaying their absorption by plants.

All these substances are partly absorbed by plants, which tend to keep the soil neutral by a process of auto-regularisation, plant growth being hindered by acidify; they are brought into contact with the water, which tends to acidify the soil by setting free its bases; the substances however are partly restored by vegetation and manuring. Many factors therefore unite to produce and regulate soil reaction. Among these, evidently decomposing organic matter exercises an important influence, but little research has been made on this question.

The author had already studied (1) the effect of the decomposition of some of these substances, nearly all of definite chemical composition; albumin, casein, dextrose, ammonium sulphate, starch, blood and alfalfa. But he wished to study other organic materials of more general use in agri-

(1) See *R.* 1919, No. 1084. (*Ed.*)

:ulture, such as farm manure, cottonseed meal, dried blood, clover and other ;reen crops, and oat straw. As in the earlier work, he used two soils, one ·ather sandy and light in colour, the other of the loam type, dark and fairly ·ich in organic matter ; tests were made in earthenware jars, fertiliser being ıdded to the soil at the rate of 5000 lbs. per acre, on the basis of 2 000 000 bs. of soil per acre ; straw was added generally in smaller quantities. In nany tests he also used calcium carbonate precipitates in half the quanti- :ies above mentioned.

Soil acidity, as determined by the TACKE method by means of hyper- ,aturating with calcium, does not increase when decomposing organic naterials are present, unless there is a large production of nitric acid. The ıddition of lime always increased nitrification ; it is evident that the lime, aturating the nitric acid, prevents the latter from becoming too concentrat- :d, in which state at a certain moment it injures the bacteria which cause ıcidity and thus automatically stops the process of nitrification. With imestone, the nitrifiers become more active ; at the same time however ımmonification becomes less intense. If nitric nitrogen and ammoniacal ıitrogen be added, smaller quantities are found in limy soils, probably)ecause the lime renders the micro-organisms more active, and these :ventually assimilate and make organic the ammonia compounds and the ıitrates, which no longer exist as such. Certain natural fertilisers, such ıs horse manure, produce small quantities of ammonia and nitrates, perhaps)ecause they cause a vigorous growth of micro-organisms. Straw also 'educes change and nitrification.

The soluble unknown non-protein nitrogen, not including the nitrates ınd ammonia compounds, showed little effect under the various organic reatments. Only the cottonseed meal gave any large increase. In all :ases liming decreased the nitrogen content.

In practically all cases the soils show reaction under acid and organic reatment, but without greatly modifying the true acidity as determined)y hydrogen-ion concentration. This is especially true of soils rich in or- ;anic matter and clay. Thus citric acid remained inactive in hydrogen- on concentration. On the other hand, the acidity was always increased)y the addition of a mineral acid, such as sulphuric acid. A similar action s certainly exercised by hydrochloric acid, acid silicates, etc., which are ound in certain manures and fertilisers. It is interesting to note that ıeutral salts act in the same way as mineral acids ; for instance, ammonium ulphate is physiologically an acid because, while destroying the organic)asic radical, the mineral-acid radical remains ; it is more active than a sim- lar quantity of albumin because the latter forms nitrogenous bases which ıitrify slowly ; on the other hand, it is more active than a like quantity of ulphuric acid. The addition of a mineral base decreases the acidity in :very case ; certain neutral salts also act as bases : thus, limestone decrease ıydrogen-ion concentration to a little over 8 pH, which seems to be the ılkaline limit caused by limestone.

L. V.

912 - **Nitrogen Economy in Soils.** — BEAR, F. E. (Professor of Agricultural Chemistry and Soils, Ohio State University, Columbia) in *Journal of the American Society of Agronomy*, Vol. 14, No. 4, pp. 136-152, bibliography of 35 works. Geneva Conference N. Y., 9 figs., bibl. April 1922.

In 1840 LIEBIG stated that nitrogen in the form of ammonia dissolved in the rain was the source of the nitrogen used by plants. Estimations carried out subsequently by LAWES and GILBERT and exact determinations made recently by RUSSELL and RICHARDS prove that the amount of nitrogen supplied to the soil in the rainfall is usually not more than from to 8 lb. annually, although occasionally the amount may be as much as 15 to 20 lb. per acre ; the quantity tends to increase with a greater rainfall and also with nearness to industrial centres.

Atmospheric nitrogen is fixed in the soil in considerable amounts by two distinct bacterial processes. One, termed symbiotic, is effected by *Bact. radicicola* which exists in the roots of leguminosae. The work of this organism can be estimated by three methods : comparison between legumes and non-legumes ; comparison of inoculated and non-inoculated legumes ; analysis of the soil before and after the experiment, taking into account the nitrogen which may be added to or removed from the soil by any cause. The amount of nitrogen supplied to the soil by this means is considerable. ARNY and THATCHER have shown recently that melilot is able to fix nitrogen to the extent of 133 lb. per acre per annum, but as a rule the quantity is very much smaller. Nitrogen fixation is known to be stimulated by the use of phosphorus, potassium and lime, and leguminous plants are thus indirectly assisted as their nitrogen requirements are supplied. Nitrogen fixing bacteria are sensitive to acid conditions in varying degrees. FRED and DAVENPORT found the *optimum* pH for soybean to be 3.4 as compared to 4.3 for those of clover and 5.0 for melilot and lucerne. SALTER finds that the *optimum* for the soil is about 1 pH higher than would be expected from culture solutions. It may be possible, as suggested by LYON, to grow acid-tolerant legumes on soils in which nitrification is retarded. In addition to the symbiotic fixation of atmospheric nitrogen there is the non-symbiotic process carried out by free-living bacteria of which *Azotobacter* is the prototype. There are other organisms belonging to this group, which are able to function in acid soils unsuited to *Azotobacter*.

It has been shown by FRED and GOLDING that *B. radicicola* has the capacity to fix nitrogen when free in the soil and absent from its host. The conditions which favour both symbiotic and non-symbiotic bacteria are similar and include the presence of carbonaceous and mineral matter; the non-symbiotic types are less active but time is on their side as they work continuously whereas the other form is active only in the presence of its host-plant ; they thus play an important part in the supply of nitrogen. Investigators have estimated the quantity of nitrogen fixed by *Azotobacter* at from 15 to 14 lb. per acre per annum. All these organisms choose the line of least resistance for obtaining their food : after the available nitrates present in the soil have been utilised they then assimilate atmospheric nitrogen (BONAZZI). A third source

rogen is that supplied by fertilisers which is more effective in some areas n others, for instance in Texas as compared with Ohio. This is related the causes of the loss of soil nitrogen which vary in different districts. rification actually entails a loss, as it renders nitrogen soluble and in s case if not immediately absorbed by plants it is easily washed away. rification is hindered by acidity and assisted by alkalinity. In cold ions both nitrification and fixation of nitrogen are slow.

The opposite is the case in warm countries. The fixation of nitrogen leguminosae is more rapid than the process of nitrification and in con-uence a storage of nitrogen results. Experiments show that the great-quantity of nitrogen is found in soils which are neutral or slightly acid that there is an *optimum* reaction of about 6 pH.

Soil nitrogen is diminished by irrigation; LYON and BIZZEL in the rse of their lysimeter experiments shewed that this loss amounted to out 3.4 lb. per acre, excluding the first year in which cultivation of the l increased the quantity; they also showed that the loss is closely related the kind of crop grown. In the absence of vegetation the nitrogen loss raged about 100 lb. per acre annually. This loss may be made up in ctice by the cultivation of leguminous crops provided that phosphate and ash salts are applied, as was shown in the cylinder tests carried out at New Jersey Station. The field experiments confirmed these results. reviewing the subject it is seen that the nitrogen equilibrium is a result many factors; rainfall, soil reaction, cropping system, temperature, nuring, irrigation, type of soil, presence of worms, insects, etc. The s may be made good by sound methods of rotation and by so doing amount of manure necessary will be reduced to a minimum. The most nomical and the best plant growth is obtained when the losses and ns of nitrogen in the soil balance each other. L. V.

The Isolation of Sulphur-Oxydising Bacteria from the Soil (1). — JOFFE, J. S. (New Jersey Agricultural Experiment Station) in *Soil Science*, Vol. XIII, No. 3, pp. 161-172, bibliography of 35 works. Baltimore, March 1922.

The author gives a general description of the sulphur-oxydising ganisms, and abstracts are here made of some of his lesser-known udies. Apart from the classical sulphur-bacteria *Thiothrix* and *Beggia-a* he mentions the following groups: 1) *Rodobacteria*, already described WINOGRADSKY, of which the typical species is given the name of *Thio-odaceen*. They were discovered in 1826 by EHRENBERG, who named them *mas okenii*; they are able to thrive in the light and need very little oxygen. *Thiosolfobacteria* discovered by NATANSOHN in 1903; in 1904 BEIJERINCK cribed a typical species of *Thiobacillus thioparus* which was able to con- thio-sulphates into tetrathionate; 3) denitrifying *sulphobacteria*, overed by BEIJERINCK in 1904 and studied by LIESKE in 1912. They known as *Thiobacterium denitrificans* and thrive in the absence of gen, which they obtain from nitrates, and liberate nitrogen; 4) another.

(1) See R. Aug. 1922, No 804. (*Ed.*)

similar group of sulphur bacteria is mentioned by DÜGGELI which are n threadlike organisms termed by HINZE *Thiophysa volutans*, *Thiospiril urinogradokii* Omeliansky, *Spirillum gralatum* Molisch. The author fers to the work of GICKLEHORN who described in a less exact manner number of sulphur organisms.

With a mixture of soil, sulphur and basic phosphate of lime, the thor was successful with a number of cultures carried out in a liquid conti ing neutral phosphate of potash, carbonate of lime or magnesia, nitrate soda, sulphur and saccharose or dextrine. In the original cultures 8 to 9 % of the sulphur was oxidised but the acidity of the mixture increased ; in many instances the cultures deteriorated but in two ca the oxidation of sulphur reached 18 %. The author tried to isolate micro-organisms by employing the same media solidified with agar obtained some bacterial colonies, both motile and non-motile and fungi. Transfers of the bacteria to the liquid media did not produce acidity equal to that of the original liquid culture medium. Pla carried out at a later stage gave no bacterial result. The author then placed sodium nitrate by ammonium chloride as a source of nitro He thus obtained a good medium in which the organisms were increasi active and gave an acidity of 1.2 pH. He succeeded in obtaining by me of these transfers a pure culture of bacteria which were very active in presence of sulphur. This organism in 150 days oxidised 48 % of the phur contained in the culture and gave a strong acid reaction below 2 He has made experiments in collaboration with LIPMAN and WACK which will be published separately. The author has shown that number of micro-organisms are able to some extent to oxidise sulph Experiments were carried out with two fungi (*Mucor* and *Fusarium*) also with two bacteria which grew well on CZAPECK'S solid medium. Th germs to some extent dissolved insoluble phosphate, no doubt owing the action of the sulphuric acid produced. These germs interact amo themselves. The author, for this reason, accepts the opinion expre by LIPMAN that the process of sulphur oxidation in the soil is a result the associated activities of different forms of micro-organisms, some which bring about the oxidation which is then continued by others.

L. V.

914 - **A Method for counting the Number of Fungi in the Soil.** — WAKSMAN, S. A. (New Jersey Agricultural Experiment Station, Department of Soil Chemistry and Bacteriology) in *Journal of Bacteriology*, Vol. 7, No. 3, pp. 339-341. Baltimore, May 1922.

The spores of hyphomycetes and other fungi in the soil are estimated by the plate method with the same media and dilutions as are used for bacteria. As these bacteria are very numerous, the dilution of the soil is necessarily very high ; but in these dilutions the fungi become so rare that very few appear on the plate : in fact many plates are entirely free from fungi. The work therefore becomes impossible, or involves great error. But if the dilution of the soil be reduced, the bacteria become so numerous as to prevent the development and consequently the numbering of the fungi

his difficulty was obviated by making use of acid media in which bacteria not develop but fungi grow readily; in this way a very low dilution soil may be used. The author now gives the formula of an acid culture hich gave very good results. In an experiment, he found 29 400 ($\pm$ 1700) rms per gram of soil, whereas with agar-agar and egg-albumen an im-ssible 460,000 ($\pm$ 94 000) were found, that is, 20 times as many; the l dilutions in these two cases were respectively, 1 000 and 200 000. e method may also be applied to the determination of the number of ngi in food preparations. The formula is as follows: glucose 10 gm.; ptone 5 gm.; acid potassium phosphate 1 gm.; magnesium sulphate gm.; distilled water 1000 cc. Boil, add sufficient sulphuric acid or osphoric acid to bring the reaction to 3.6 to 3.8 pH (usually 12-15 cc. sufficient); add 15 gm. of agar, boil, run into tubes and sterilize as ual. The final reaction should be 4 pH.

L. V.

- **"Plant Cancers" and their Relation to the Soil: studied on the *Beta vulgaris*.** — LEVINE, M. in *American Journal of Botany* Vol. 8, No. 10, pp. 507-525, bibl. of 18 works. Lancaster, Pa., Dec. 1921.

The numerous varieties of *Beta vulgaris* are subject to a sporadic dis- which shows itself in the form of large tumors on the roots. There two kinds, one called crown gall and the other tubercular disease. They caused by two bacilli, respectively known as *Bacterium tumefaciens* *Bacterium beticolum*, which were discovered by SMITH, BROWN and NSEND (1911). TOWNSEND (1915) concluded that the galls have no ked effect upon the size of the sugar beet and JENSEN (1918) found they no detrimental effect on mangel wurzels. He observed that the large or-like formations on the sugar beet are of very irregular structure and the tumor in almost every case is small in the garden beet. Many tions still remain to be decided: to ascertain more exactly the effects e tumor on the roots and leaves of the plants attacked; to determine ause of the greater susceptibility of the sugar beet in comparison other varieties of the *Beta vulgaris*; to try to produce races proof ack which will retain their qualities; to differentiate the two kinds rom the histological point of view, and to study the relation of to the soil.

hor undertook this last problem and proceeded to solve it research and weight determinations. He experimented on f *Beta*: mangel wurzel and two garden varieties. When the egan to appear, he inoculated them with from 5 to 10 injections a needle dipped in a culture of *Bact. tumefaciens*; 3 types of hus regularly produced: smooth, warty and mixed. For the r kinds of soil were used: garden soil mixed with plenty rown clay loam with manure; the same without manure; he growth of the plants decreased in the same order and that s also diminished in the same proportion. In the first soil a ilt was observed; in the two highly manured lots, the inoculated tzels showed vigorous growth and the tumors on their roots were

large, whereas in the sandy unmanured lot the plants and tumors were poorly developed.

This disease therefore seems to develop more actively on the better nourished plants, especially those treated with nitrogen compounds. The writer recalls certain similar facts observed with regard to other plants. He also points out that the analogies of crown gall with animal cancer, recognised by SMITH, JENSEN, the writer and others, are increased by this action.

L. V.

916 - **Soil Factors and Plant Growth.** — MOORE, B., in *Ecology*, vol. 3, No. 1, pp. 65-83, 6 figs., bibl. of 12 works. Brooklyn, Jan. 1922.

Among recent investigations on the importance of the soil in controlling plant growth and distribution, that of FERNALD on the distribution of *Pinus Banksiana* and *Thuja occidentalis* in connection with geological formation, and that of HESSELMAN on the importance of different kinds of humus in Swedish forests are deserving of attention. The beneficial influence of humus on plant life has long been recognised, but it was attributed solely to its effect upon the water-holding capacity of the soil and to its rendering the latter lighter and better ventilated, whereas HESSELMAN recognised that it is an effective agent in nitrogen production. The influence of soil reaction on plant growth has often been studied, but most attention has been given to acidity and alkalinity has thus been neglected.

The writer has studied the influence of humus and alkalinity on certain conifers (3 pines and a cedar: *Pinus rigida, P. Banksiana, P. Resinosa* and *Thuja occidentalis*), on a sugar maple (*Acer saccarum*) and on wheat. The soils were of pure sand, pure humus and a mixture of 80 % of sand with 20 % of humus. To eliminate the effects of the greater moisture-holding capacity of the humus, the soils were kept continually moist. For the plant-growth determinations, the height from the ground and the depth of the roots (of the pines only) were measured, the green weight was taken, and also the dry weight of wheat. Certain qualities, as indicated by appearance, colour, etc., were also noted.

On the whole, growth was difficult in sand, less so in the mixture of sand and humus and vigorous in humus, in spite of strong acidity. Evidently humus supplies nutriment which can be no other than nitrogen.

As regards conifer seedlings, the influence of humus was greatest in the case of *Pinus Banksiana* and *P. rigida*, less with *P. resinosa* and still less with *Thuja occidentalis*, which came up with difficulty in spite of the humus. These results lead to the conclusion that humus is especially beneficial to trees which in a natural state also grow on sterile soils; on the other hand, trees which require better soils find humus insufficient. The growth of wheat, a cultivated plant, was also little affected by humus with the exception that it favoured the growth of stems or shoots owing to its rich nitrogen content as compared with its carbon content. This accords with the observations of other writers.

Soil alkalisation was produced by the writer by means of quick-lime He tried two types, one stronger (with 2.0 %, 2.4 % and 4.0 % of lime

according to the soil type), and the other lighter (with 0.75 %, 0.8 % and 0.5 % of lime). Even a weak alkalisation still had a very unfavourable influence on seedlings, with the exception of those of the cedar. Sugar maple seedlings when transplanted all died immediately, except those planted in the sand. Numerous seedlings of other species also died ; those which survived were poor in growth. The roots of the conifers became brown and shrivelled. This injurious effect diminished in time but was still marked after 40 days.

Large quantities of lime also had a decidedly unfavourable effect on wheat, not so much as regards height as weight, which was taken both before and after drying in an oven. This effect was more marked in cultures made in sand or with a little humus ; it was hardly noticeable in pure humus cultures. On the other hand, moderate quantities of lime showed a favourable influence, especially on humus cultures, in which, with the addition of lime, wheat grew better than in the untreated soil.

Wheat therefore differs from trees in this respect, which shows that are should be taken in applying the results obtained with cereals to trees, nd vice-versa. L. V.

917 - **Soil Acidity and Plant Composition of a Peat Bog.** — MOORE, B. and TAYLOR, N. (Brooklyn Botanic Garden), in *Ecology*, Vol. 2, No. 4, pp. 258-261. Brooklyn, Oct. 1921.

Mt. Desert Island lies off the eastern coast of the state of Maine. The predominant vegetation is northern, with a number of arctic alpine plants, but southern forms are also found. A similar combination of northern and southern forms is found in the insect fauna of the island. On the south side of the island is a small bog 50 yds. long by 25 wide, which s caused by an undrained depression in a granite formation which forms a great part of the island. The bog is covered with marsh plants, chiefly sedges. Its specific acidity is pH 4.5-4. The drying up of the water n summer, instead of making the acids stronger through higher concentration diminishes their intensity. Around the edge of the bog is a granite outcrop covered with vegetation. Under the roots of the *Empetrum nigrum* the acidity is lower, being pH 5.0 only.

Round the margin of the bog is a stunted growth of black spruce (*Picea nigra*) with a mixture of larch and other plants ; here the acidity s still lower, being pH 6. In these three zones of varying acidity, the flora changes not only according to environment, but also according to origin. In the first zone, there are 25 % of arctic alpine plants, in the second 6.3 % and in the third, none at all. In the author's opinion, the first zone contains the older species and the other two zones contain a progressively increasing number of those subsequently introduced. L. V.

918 - **Influence of Soil Reaction on Earth Worms.** — ARRHENIUS, O. (Stockholm), in *Ecology*, Vol. 2, No. 4, pp. 255-257, bibl. of 7 works. Brooklyn, Oct. 1921.

After referring to the brilliant studies by C. DARWIN and P. E. MÜLLER, according to which the presence or absence of earth-worms largely determines the condition of the soil as regards acidity, the author mentions a hypothesis previously formulated by himself viz., that the two kinds

of soil depend, on the contrary, upon their hydrogen-ion concentration. Against this hypothesis it could be objected that the earth worms are capable of causing both the chemical reaction and the soil type. The author therefore wished to discover what modifications may be produced by earth worms on soils with different reactions. He modified the soil reaction by adding decinormal solutions of sulphuric acid and potassic hydrate or iodine hydrate, in each case with the same quantity of water (50 %). After the preliminary experiments, by simple interpolation calculations he prepared a series of soils measuring entire units of pH from 3 to 10. After having checked the hydrogen-ion concentration of this soil, he added a certain number of earth worms. After the first series of experiments in the "Treublaboratorium of's Lands Planentuinë", Buitenzorg, with the usual Javanese earthworm *Perichaeta indica* Horst, the worms, after 4 or 5 days, were living and vigorous. In pH 6 and 7 concentrations, there had even been propagation, whereas, in the other concentrations, the worms were dead or dying. In another experiment in the Laboratory of Soils and Bacteriology, in the University of California at Berkeley, the results were even more convincing with *Lumbricus terrestris* L. After 3 ½ days the worms only remained alive in the pH 6 and 7 concentrations. This proves that earth worms not only cause soil reaction but are themselves strongly influenced by it. This is in accord with the experiences of other authorities. For instance, PRESCOTT informed the author that in Egypt there are no earth worms in the best soils; and from the observations made by the author, nearly all good Egyptian soils have a pH above 7.5. The observations of A. F. SHOHL and SH. HURWITZ may also be quoted, according to which the irritability of the earth-worms (*Allobophora foetida* Sav.) is proportionate to the hydrogen- and hydroxyl-ion concentration.

To conclude, in the author's opinion, the reaction is the primary factor in the soil type.

L. V.

919 - **Quantity of assimilable Phosphoric Acid and Potassium in Soils.** — BRIOUX, CH. in *Annales de science agronomique*, Year XXXIX, No. 2, pp. 82-100. Paris, March-Apr. 1922.

Agronomists and chemists still disagree as to the utility of chemically analysing arable land, such analysis as yet being far from a sure guide as to what, if any, fertiliser should be used. From deductions made which have been disproved in practice, the utility of this analysis has been questioned. It has been confined, in fact, to determining the four principal elements forming the fertilising reserve of the soil: total nitrogen, phosphorus, potassium and calcium, the last three being soluble in concentrated boiling acids. It is useful to know the quantity of nutritive reserves, but this will only be of relative value if the proportion of fertilising elements which may be available for plants, cannot be estimated at least approximately; this proportion indicates the degree of fertility.

Some important data have already been ascertained. The problem is to find the solvent to be adopted which would have an action comparable to that of the roots of the plants cultivated, or preferably, to that of

ie general phenomena of solubility through which the plants can be nourhed. The author tries to find solvents which, with the present means of ıalysis, will give results more in conformity with those obtained in practice. mong other experiments, the author makes a comparative study of two ıethods for estimating the assimilable phosphoric acid and potassium iz., B. DYER'S and TH. SCHLOESING junior's afterwards A. DE SIGMOND'S, ıethods.

DYER, who had at his disposal at the Experimental Station of Rothamed soils which had received applications of fertilisers for 30 years of which ie action was perfectly well known, employed the following method: fter having determined in a large number of plants the acidity of the ıp contained in the fresh roots, which is about 0.85 %, he treated them ith a solution of citric acid at 1 %, finding between the parts untreated and ıose phosphated a ratio of 1 : 1.7 for the total phosphoric acid; soluble in oiling hydrochloric acid, and 1 : 6 for phosphoric acid soluble in weak tric acid. It may be presumed that the latter only dissolves the phoshoric acid which can be assimilated by the plants and is found ı small quantities in the untreated parts; hence the marked difference etween the terms of the second ratio. DYER obtains similar figures for otash. On comparing the results of the analyses with those of the culıres he confirms the fact that citric acid acts on phosphates and potash ı nearly the same way as the natural solvent formed by the plants.

He gives the following practical rules: arable soil should contain at ıast 5.10 ‰ of phosphoric acid soluble in 1 % citric acid for cereals and h appreciably higher percentage for root cultures. Though it is diffiılt to foresee whether the addition of potassic salts is beneficial, the figes for potash are the same.

GAROLA in applying DYER'S method, increased the limits slightly, nerally using phosphatic fertilisers when he found only 0.1 to 0.2 ‰ assimilable phosphoric acid. When the phosphoric acid soluble in ric acid reaches the figure of 0.3 ‰, the utility of these fertilisers ceases om the economic point of view. The utility of potash in an assimilable m continues up to 0.15 ‰; these methods indeed appear to agree in sults with those obtained when fertilisers are applied to cultivated soils, ovided the latter are not calcareous. DYER himself thinks that for these arger quantity of citric acid is necessary so as to neutralise the carbonate lime they contain. Further, for soils containing 15 to 20 % of carnate of lime, which is not unusual, the method is uncertain in its results; e citrate of calcium formed, covers the seeds with carbonate of lime d limits its action; the evaporation and calcination which follow should o be taken into account.

These reasons induce the author to give up citric acid as a solvent and ke a comparative study of the method, the principle of which was inted by TH. SCHLOESING Jun. and its technical application by DE SIGND. SCHLOESING divides phosphates into two distinct groups: those ich are soluble in 0.5 ‰ citric acid and those soluble in about 1 ‰. the first of these groups, the phosphoric acid dissolved should belong to

phosphates with a calcium, magnesium and alkaline base, but not to those with an iron and aluminium base, which dissolve at an acidity of over 1 ‰. Soils from which the excess of phosphoric acid is separated with very weak acids are the same as those from which this excess is removed by water and other solutions with which they come contact. Hence it is concluded that this phosphoric acid belongs to the first group. De SIGMOND confirms the existence of these two groups of phosphates, finding in 12 of the 14 kinds of soil examined that the quantity of phosphate dissolved, at acidities between 10‰ and 1 ‰ per unit of nitric acid, is invariable. In operating on 100 samples in which the need for phosphoric acid had been proved by experiment, he observed that though there is no constant connection between the total phosphoric acid content and the phosphate requirement of soils, there is a very close connection between the amount of phosphoric acid in an assimilable form and the need of a soil for phosphatic fertiliser.

The author adopts SIGMOND'S method, applied in such a way that the final acidity is always between 200 and 1000 mg. per unit of nitric acid and preferably about 500 mg. He uses a titrated solution of nitric acid of which 1 cc = 100 mg. of nitric acid and a solution of potassium hydrate of which 1 cc. = 10 mg. of nitric acid.

In a large number of soils, more or less rich in carbonate of lime, the author, by using the official, DYER'S and SCHLOESING'S methods, also determines the quantity of assimilable potassium dissolved in nitric acid at a concentration of approximately 0.5 ‰. He gives two tables in which the soils are grouped according to increasing basic content which give an exact explanation of the two methods.

DYER'S method gives a higher return of phosphoric acid than SCHLOESING-DE SIGMOND'S, this being due to the fact that citric acid at 1 % is a good solvent both of iron and aluminium phosphates and also of soil and alkaline soil phosphates in slight combination.

HALL and DEMOLON maintain that all the phosphate combinations found in soil appear to be represented in DYER'S citric solution, for besides calcium there are organic matter and salts of iron and aluminium. A possible objection to DYER'S method is that it is not easily applied to all soils, calcareous or otherwise, and that it dissolves iron and aluminium phosphates too easily, which phosphates are considered to have less easy access to plants than calcium and magnesium phosphates. This method however, has been of great service in the analysis of silicious soils containing lime or clay.

The SCHLOESING-DE SIGMOND method has the advantage of rapid and easy application to non-calcareous soils as well as to those which are highly calcareous. It also appears to allow a better classification of soils which are to be treated with phosphate applications.

The relative assimilability however of the soil phosphates in slight combination, soluble in nitric acid at 0.5 ‰, and the more or less gelatinous iron and aluminium phosphates which are to be studied, should be borne in mind.

The quantities of assimilable potash separated are smaller than those phosphoric acid, probably because potash enters into less varied combin- ions. The limits which show a poorness in the soil content of potash ay be considered as being 0.20 ‰ by DYER's method and 0.30 ‰ by :HLOESING's.

In conclusion, the author thinks that soil analysis limited to the study its four principal elements is insufficient for fixing the phosphoric acid id especially the potash needs of the soil. He admits at the same time that e DYER and SCHLOESING-DE SIGMOND methods mark a great advance id are, together with the official method of determining by concentrated iling acids, almost exclusively employed up to the present, of great help these researches.

R. P.

o - **Necessity for defining Soil Types in Investigations on Yield.** — BROWN, P. E. (Professor of Soil Bacteriology, and Chief in Soil Chemistry and Bacteriology in the Experiment Station, Iowa State College, Ames, Iowa), in *Journal of the American Society of Agronomy*, Vol. 14, No. 5, pp. 198-206. Geneva, N. Y. May 1922.

Until comparatively recently there has been a tendency to make a neral application of culture investigations, the results of which, on e contrary, apply only to the soil used. The numerous disagreements d contradictions in the results obtained by different investigators, and en by the same investigator, should be attributed in a great measure to e fact that conditions were different and above all that different soils ere used. Many of the failures of farmers when applying these results field work are due to this ; hence the distrust in these experiments felt practical men. Nevertheless, agriculture is greatly indebted to experi- ental work, which has proved of inestimable economical value and eds no apology.

Few of the results of experiments apply to *all* soils ; generally, the par- ular soil type should be taken into account. Numerous investigators ntinue to ignore this essential feature. This is partly explained by the ct that they wish to make the best of their results by applying them gen- lly ; at the same time the farmers ask for advice which may be put into actice without difficulty and with the fewest possible restrictions. It ould be remembered also that the experimental stations and scientific oratories have a tendency to publish as much as possible and that the estigators desire to make themselves known early and to acquire hon- rs, which blunts their critical sense and leaves their published work fective. There is a tendency to arrive at hasty and too generalised nclusions which leads to disillusion. Applications should be more specific.

Care should be taken however not to fall into the opposite extreme, LIPMAN and LINHART have done, according to whom fertiliser tests e of very limited application, of no practical value and do not justify e expenditure of energy and money involved. This hypercritical attit- e has no foundation; unfortunately it influences the uninitiated and ings discredit on soil experimental work in the minds of other entists, farmers and co-operative societies.

[919-920]

What is of importance is to determine the soil type when making investigations. Once this is done there can be no question but that under the same conditions results on the whole will be similar. After a very long experience, the writer is convinced that the classification by the U. S. Bureau of Soils gives a sound definition of soil types. This classification includes several hundreds of types; in some cases even the distinctions are so fine that it is impossible to distinguish the types described and this involves too much of the personal equation. In spite of this defect however, it is fundamentally sound and offers a firm basis for scientific and practical men.

To prove the different reactions of dissimilar soils treated with the same fertiliser, the writer describes numerous field experiments carried out on 10 soils to which he applied 5 kinds of fertilisers and on which he cultivated oats, clover and maize, and also pot experiments on 9 soils treated in the same way and on which wheat and clover were grown. Certain fertilisers proved beneficial, though in varying degrees, to certain cultures on all the soils; thus, lime to clover and manure to maize and oats. Other treatments however gave very different results with the same crop on different soils. Thus, in a pot test, a complete fertiliser gave an increase of 60 % in clover yield over the control in one soil, and 900 % more in another. Different soils, therefore, may respond in a very different way to fertilisers and correctives. This fact is well known as regards sulphur, potassium, etc. The influence of fertilisers as regards the nitrogen content of tops and roots varies; that on bacteria also varies, and the author has made a special study of this question. Other investigations have been made by him to determine the relations between the soil type and its chemical composition.

L. V.

921 – **Relations between Soil Type and Root Form of Pine Seedlings.** — HAASIS, F. W. (United States Forest Service) in *Ecology*, Vol. 2, No. 4, pp. 292-303, 3 figs., bibl. of 8 works. Brooklyn, Oct. 1921.

While studying the natural reproduction of *Pinus ponderosa scapulorum* at the Fort Valley Station, Flagstaff (Arizona), the writer has been trying during the last two years to correlate the character of root development of the young seedlings with the types of soil. He has made a study of 286 plants divided into six age classes. The soils, almost all of basaltic origin, but some also composed of cinders (volcanic), were divided into five groups: 1) *Stonyclayey*, compact, stiff, but modified by stones and stony rocks; 2) *Gravelly-loamy*, light and moderately porous, not baking or crusting when dry and with a few stones (these two types are the most frequent in the area studied); 3) *Loamy-rocky*, mellow, dark-coloured, moderately rich in humus, with many stones (a little less common than the two foregoing); 4) *Clayey*, very compact, least porous, not well aërated, deep, retaining moisture and most fertile; 5) *Cindery*, loamy, porous, with coarse cinders below or in the middle (the least frequent). The roots, complete, with all their lateral rootlets, were divided into 8 categories: filiform (only met with in the first stage of growth), bifurcate,

muscoid, obconical (like an inverted cone), clavate, fusiform, cylindrical and ramified (without main root). The main roots may have one of these types. There is a special form of fan-like ramification. The most usual forms were obconical and cylindrical, next came the clavate and fusiform.

In clayey soils, lateral roots were scarce; they were more frequent in stony-clayey and gravelly soils, and abounded in loamy-rocky soils. In the coarse-cindery soils, the largest number of ramified roots were found; these were rather rare in the other soils, especially the clayey ones. The same was noted in the case of the fan-like ramifications.

In general, two extreme root growths were observed: one, in clayey soil, was characterised by a minimum number of laterals and by " branching "; the other, in coarse-cindery soils, by a maximum of laterals and branching.

The more clayey the soil, the longer is the root and the smaller the ratio between top and root; the more loamy the soil, the shorter the root and consequently the greater the above ratio. This had already been observed by WEAVER. It is not in direct relation with the available moisture of the soil and in fact tests have proved that the smallest quantity of available water was held by stony-clayey soils and the largest quantity by coarse-cindery soils. L. V.

922 - **Influence of Irrigation on the Composition of the Soil.** — GREAVES, J. E. (Department of Chemistry and Bacteriology, Utah Agricultural Experiment Station, Logan), in *Journal of the American Society of Agronomy*, Vol. 14, No. 5, pp. 207-212, bibl. of 7 works. Geneva, N. Y. May 1922.

Water has a double action on the soil. It assists or hinders the normal development of the processes in the soil, and its most manifest influence is over the process of nitrification, of which the maximum is attained when the soil contains 60 % of its water-holding capacity. Above or below this concentration, there is a decrease; and nitrification ceases when the quantity of water reaches or exceeds 90 %. As regards nitrification, therefore, an excess of water is more detrimental than an insufficiency. Under good moisture conditions, from 50 to 100 lb. of nitric acid may be produced in an acre of soil during a season; it is a well-known fact that this acid is of great assistance in the liberation of phosphorus and potassium. The moisture content acts similarly, but in a less degree, on ammonification, the maximum production of which is also reached when the soil contains 60 % of its total water-holding capacity. All the other processes which take place in the soil are also dependent on its water content: for instance, the production of carbonic acid gas, which may be as much as 60 l. per acre per day, it also plays an important part in the solution of tricalcium phosphate. Finally, it influences the production of lactic, acetic, butyric, sulphuric, and other acids, which help to dissolve potassium, etc.

The other fundamental action of irrigation water is that it brings or carries away plant food; it impoverishes or enriches the soil. To gain an idea of the enormous quantities of substances that water may carry

off from the soil, it is only necessary to consider the constituents of river water. The substances in solution such as for instance, sodium chloride are not generally of any importance in agriculture, but useful substances, such as potassium, nitrogen and phosphorus, are not lacking. The writer describes certain analyses on this question. Some irrigation drain waters are still richer; certain of them contained as much as 133 pounds per acrefoot.

When irrigation is carried out properly, the water, as it evaporates, deposits the substances it contains, as in the case of the Nile. Thus, in Utah, the waters used for irrigation contain 0.79 to 59.0 parts of potassium per million, or an average of 5 parts which may be used by the soil. Irrigation waters contain besides potassium, nitrogen and other useful soluble substances; they are therefore capable of improving the soil. The great point is to irrigate *in moderation* in order not to *wash out* the soil. Irrigation may transform the desert into a garden or render the most productive fields barren, according as it is well or ill done. L. V.

923 - **The Culture of Cereals in Furrows.** — CHAPLIN, M. S., in *La Gazette Agricole du Canada*, Vol. IX, No. 2, pp. 120-125. Ottawa, Mar-Apl. 1922.

The development of Saskatchewan is due to its wheat and oat production. To keep the soil moist and destroy weeds, the farmers let the land lie fallow once every two, three or four years, according to local conditions of soil and climate. This system generally gave good results in the different districts so long as land was cheap and the selling price of wheat and other cereals comparatively high; also provided the soil kept its original firmness sufficiently to prevent the plants being lifted by the wind.

At the present time certain factors compel the Prairie farmers to modify this system.

It would be difficult to say which is the chief among these factors, but each of them has an influence.

In many districts, trouble is caused by dust storms. Fallow land is exposed to the weather the whole year round and there is consequently a displacement of soil. The effects of the dust storms are so evident that it is needless to allude to this point (1).

The market prices of cereals are no longer maintained at the high level due to the war. Means must be found for producing at prices sufficiently low to compete with other countries in the world markets.

In certain districts the price of land has risen to such an extent that the interest and taxes on an acre of fallow-land have become a considerable burden, eliminating all hope of profit on wheat production, even when they do not show a loss.

This being so, it is clear that at the present stage of development in Canadian agriculture, all crops cultivated in furrows which can replace at least a part of fallow-land will be considered useful. Some farmers

(1) See *R.* Feb. 1922, No. 143. (*Ed.*)

are trying maize, others potatoes. These crops are useful over a very limited area, but something must be found which can be cultivated extensively so as to replace a considerable part of the present fallow-land.

Guided by previous experience the author has decided to carry out experiments at Saskatchewan to see if grain culture in furrows can replace the fallow-land.

Some preliminary experiments were made in 1921. The plots on which they were carried out were rather large, measuring 0.4 acres each and gave very encouraging results. Trials were made with wheat, oats and barley. Each crop was sown in groups of 3 rows, with 30 inches distance between each group and in groups of 2 with 36 in. between them. For comparison, a table is given showing the yields from both methods of the first and second crop after the land had been lying in fallow during the summer. The grain in furrows was sown on soil which had borne oats the previous year, 1920, and various crops in 1919, and had not lain fallow in 1918. The following is the grain and straw yield in kg. per ha.

Method of sowing	Grain	Straw
	Kg.	Kg.
« Marquis » wheat.		
Ordinary on fallow land	42	4.10
Ordinary on Autumn tillage	42	3.67
Double rows with 91 cm. between	20.95	1.07
Triple rows with 76 cm. between	25.02	1.27
« Banner » Oats.		
Ordinary on fallow land	94.55	5.90
Ordinary on Autumn tillage	67.95	3.07
Double rows with 91 cm. between	67.47	0.85
Triple rows with 76 cm. between	72.35	1.07
« Hannchen » Barley.		
Ordinary on fallow land	67.02	3.62
Ordinary on Autumn tillage	63.97	2.77
Double rows with 91 cm. between	42.27	0.63
Triples rows with 76 cm. between	55.92	0.80

The Department of Animal Industry has also sown oats in furrows as pasture, to replace summer fallow, with very satisfactory results.

F. S.

924 - **The Sowing of Seeds and Scattering of Chemical Fertilisers simultaneously in parallel and close Lines.** — BANDRY, A., in *Comptes Rendus des séances de l'Académie d'agriculture de France*, Vol. 8, No. 20, pp. 574-580. Paris, 1922.

Low crop yield is due less to the insufficiency of chemical fertilisers used than to their imperfect utilisation by the crops. It was decided to place within immediate reach of the young plants the mineral nutriment needed by them from the earliest stages of their growth. For 15 conse-

cutive years the author studied the application to extensive cultures of the simultaneous scattering of chemical fertiliser and seed grain in close parallel lines. The results obtained are as follows:

1) The maximum profit in practice from crops, both of cereals and pulse, has always been obtained by using quantities of chemical fertilisers varying from 300 to 400 kg. per ha.

2) With more than 400 kg. of chemical fertiliser the value of the increase in weight of the crops did not correspond with that of the increase in weight of the chemical fertilisers used.

3) The yield per ha. of useful dry matter from the crops obtained by using 200 to 400 kg. of chemical fertilisers spread in lines has been at least equal and often superior to that obtained on the same soil by using 600 to 1000 kg. of the same fertilisers distributed in the usual way.

4) Chemical fertilisers sown in lines at a depth of 2 to 3 cm. in close proximity to the seed have a beneficial effect on the young plants.

The author concludes that this method of rational utilisation of chemical fertilisers is so effective that it has become possible to reduce the quantities hitherto judged necessary to ensure the maximum practical profit from crops by 50 to 60 %. S. F.

925 - **Thirty Years of Field Experiments with Crop Rotation, Manure and Fertilisers.** — MILLER, M. F., and HUDELSON, R. R., in *Missouri Agricultural Experiment Station Bulletin*, No. 182, pp. 1-43. Columbia, Missouri, April 1921.

The author proposed to ascertain the effects of crop rotation and continuous cropping upon unmanured and manured soil respectively. They realised that experiments over a long period are necessary in order to reduce to a minimum the influence of seasonal variation and to secure reliable results from the various rotations.

The data here reported include the results of 30 years experiments (1888-1918) with different systems of crops, manures and fertilisers, designed to ascertain not only the effect upon crop yields, but also upon the soil.

The soil of the experiment field was a silt loam of a dark brownish grey colour, the surface drainage was generally good and the soil fairly uniform in fertility. The field was divided into 39 tenth-acre plots at first, though these were afterwards reduce to one-thirteenth acre and subsequently to one-fourteenth acre. The plots were planted with continuous crops and rotations of maize, oats, wheat, clover and timothy.

These crops were grown at the same time on untreated plots, on plots given manure, plots given chemical fertilisers such as nitrate of soda, muriate of potash and superphosphate, as well as on plots receiving both manure and fertilisers.

The applications of manure were much larger than is usual on the average farm (7-9 tons per acre); hence the effects upon the soil and crops were intensified, but weed growth was encouraged so that the grass and clover crops sown with the crops were smothered, and lodging was induced in wheat and oats.

The fertiliser treatment was based on the quantitative chemical analyses of the crops, the different elements being added in the same proportions that they were removed in maximum crops. The plot on which wheat was continuously grown received sufficient nitrogen, phosphorus and potassium to equal the amounts contained in a 40-bushel wheat crop and the accompanying straw.

From the experimental data collected by the authors it appears that:

1) *on untreated soil*, rotation gave very superior results to continuous cropping. In the case of maize, the yield is increased by lengthening the period between the crops, as is shown by the following figures:

20.9	bushels	with continuous cropping		
32.6	»	» 3	years	rotation
38.5	»	» 4	»	»
41.5	»	» 6	»	»

In the case of the other crops, the maximum yield is obtained from 4 years rotation.

In the opinion of the authors, the low yield obtained by continuous cropping is due to several factors among which are insect enemies, weeds and disease, which are all favoured by growing the same crop on the same field year after year.

2) *On soil treated with manure* so as to maintain its fertility, rotation gave better results than continuous cropping, although the differences in the yields of the various crops were not so great as in the case of the experiments carried out on unmanured soil.

The use of manure greatly increased the yield of continuous crops, especially in the cases of maize, wheat and oats, the average increase recorded being as follows:

Maize	14.0	bushels	per	annum	per	acre
Oats	10.4	»	»	»	»	»
Wheat	8.6	»	»	»	»	»
Clover	827	lb.	»	»	»	»
Timothy	2325	lb.	»	»	»	»

The above figures show the high value of manure on wheat, maize and timothy, the effect on continuous clover not being so good.

In the course of the long experiment period, it was found that a three-year rotation on an unmanured soil gives lower yields than are obtained from continuous crops on manured ground, whereas with a long rotation (4-6 years), better results are obtained than from continuous crops grown on manured soil. Judging from the soil analysis, it is evident however that manure is more effective than rotation in maintaining the fertility of the soil. In fact, although by means of careful rotation it is possible to some extent, to relieve soil exhaustion all the elements required cannot be supplied by this means. A combination of rotation and manure is best.

3) *On soils treated with chemical fertilisers* the yield of the crops was

kept up as well as when manure was used. On comparing the different results obtained it is seen that maize does better with manure, but wheat and oats are better with fertiliser. In general, this relative response of the different crops to manure and fertiliser agrees with the results of numerous other experiments made at the Missouri Experiment Station and at the Rothamsted Experiment Station in England, and the Pennsylvania Experiment Station.

Chemical fertilisers, especially phosphates, are particularly to be recommended for wheat.

In the case of plots receiving fertilisers only, even in the one cropped continuously with wheat the soil was not appreciably more compact than that of similarly cropped plots without treatment, contrary to the generally received opinion that large quantities of sodium nitrate tend to deteriorate the soil texture.

4) *On soil treated with half manure and half fertiliser*, better results were obtained than with chemical fertilisers alone; therefore mixed fertilisers are the best to employ as they also maintain the soil fertility. To determine the effect exerted on the soil by different methods of cropping, the authors had recourse to chemical analysis. At the end of 25 years samples were removed from the different plots and the nitrogen content was taken as an indicator of the amount of organic matter in the soil. Maize was found to be the most exhaustive crop as regards the nitrogen, after which come oats and wheat. Timothy appears to exhaust the soil least. As a rule, rotations are less exhaustive of soil nitrogen than any single crop. This may be due to nitrogen fixation by bacterial agency.

Chemical fertilisers, even when used in large quantities, did not keep up the soil nitrogen. Evidently most of the nitrogen not immediately used by the crop was removed by leaching, or denitrification. Manure on the other hand proved very effective in maintaining the nitrogen supply.

This long series of experiments proved that, in general, *crop rotation gives better results than continuous crops*. Among the rotations used the four-year rotation of maize, oats, wheat and clover gave somewhat better results than the others. In order to obtain good crops the soil must also be manured. As a rule, farmyard-manure and chemical fertilisers proved of about the same value from the point of view of crop yield, but farmyard-manure was more effective in maintaining the fertility of the soil.

The application of a mixed fertiliser has proved to be the best method to maintain heavy crop yields without exhaustion of the land. L. M.

926 - **Relation between Nitrogen in the Soil and Livestock Farming.** — WILLIAMS, C. (Director of the Agricultural Experiment Station, Wooster, Ohio), in *Journal of the American Society of Agronomy*, Vol. 14, No. 5, pp. 159-162. Geneva, N. Y., May 1922.

Since 1910 the writer, has been making comparative experiments at the Station which he directs, in livestock farming and the direct utilisation of the various crops. The rotation followed is maize, soybeans, wheat and clover. Each area receives 2 tons of ground limestone and 700 pounds of 16 % acid phosphate per acre, per rotation. In the first system, all

the crops except wheat are fed to livestock or passed into the manure as bedding and the manure is applied to the maize crop ; in the second, the maize, soybeans and wheat are removed and sold, the hay and straw being left upon or returned to the land ; and the clover is not harvested, but allowed to stand until ploughed under the following spring. The comparison shows the superiority of livestock farming, which increases the crop production and the nitrogen content of the soil. L. V.

927 - **Fertilisers in Indo-China.** — MANGIN, L., in *Comptes Rendus des Séances de l'Académie d'Agriculture de France*, Vol. 7, No. 37, pp. 794-803. Paris, Nov. 30, 1921.

The author, acting for the Economic Agency of Indo-China states that this country has imported very little chemical fertiliser up to the present. In 1913 not more than 3 419 qx. were imported, including chloride of potash, nitrate of soda, nitrate of potash, superphosphates and other fertilisers. During the war the quantity was still lower. In 1920 the Central Government had 433 tons of potassic fertilisers sent from Alsace on account of several planters' associations.

With the progress made in agriculture, the use of chemical fertilisers, based on a knowledge of the chemical composition of the soil and the necessary fertilising elements, will doubtless become more extended.

The Central Government has had analyses and enquiries made in the countries of the Union of Further India (" Union Indo-Chinoise ") in order to ascertain the sources of fertilising matter in each district, their need of fertilisers and the most effective way in which to extend their use. The results of the enquiries are as follows :

Cochinchina. — Without taking into consideration farmyard manure, the fertilisers from local sources are: silk-worm waste, bat guano, fish offal and the remains of fish and crustacea left over from the manufacture of Nouc-mam, a kind of pickle used as seasoning, arachis oil-cake, copra, sesame, castor-oil, etc., barley waste from the distilleries and waste from the rice-crushing mills.

The Works of the Indo-Chinese Distillery C° at Cholon can produce 2000 kg. of dry barley waste, phosphated or otherwise, daily.

M. VIEILLARD, Inspector of the Agricultural Services, has classified the soils of this country from the chemical point of view as follows :

1) Alluvial marine soil of old or recent formation ;
2) Alluminous soils ;
3) Alluvial soils from the valleys ;
4) Grey soils ;
5) Red soils.

Natural phosphates may be applied to nearly all the soils of Cochinchina except the red earths.

Mineral superphosphates, bone superphosphates and basic slag might be imported from France, but in most cases the natural phosphates of Tonkin and Cambodia will also be effective and cheaper.

Cambodia. — This country up to the present has only imported crab ertiliser for pe ar culture. The amount imported annually may be